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Improving the Development of Projects in Industrial Engineering using Multimedia

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Abstract

In this work, multimedia was used as educational resource in order to provide students of mechanical engineering a detailed knowledge of the industrial manufacturing processes. A better understand of the role that machinery and technical equipment play in the development of a productive activity is required by students to improve the execution of projects proposed in the subject of Technical Office.
Diverse audiovisual material was elaborated to expose technical characteristics and operation methods of industrial equipment, to analyze the indispensable role of the safety devices and to acquire appropriate criteria of machines selection within a production process.

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Keywords: Projects; Industrial equipment; Multimedia

1. Introduction

Learning based on collaborative projects is a commonly used methodology in educational practice (Maldonado, 2008) and particularly, in the development of engineering projects. In the case of mechanical engineering, applying this methodology should allow to the students achieving the main competences associated to their professional profile (Yáñiz and Villardón, 2006).

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The students of the Technical Office subject, organized in groups, have to carry out the project of an industrial installation, justifying their technical and economic viability (De Cos, 2007). A successful execution of the project involves selecting appropriate machines and industrial equipment to carry out a manufacturing process, establishing correct security measures to avoid accidents along the global process and determining reasonable capabilities and production costs.

Resources used by the teacher to reinforce cooperation within the group and to promote a knowledge aimed at the direct application of contents (Díaz and Hernández, 1999), are necessary to improve the development of the projects proposed in the subject. Actions focused on improving collaboration among members of the group are under development in this moment, for example, the use of a networking environment to share and edit documents.

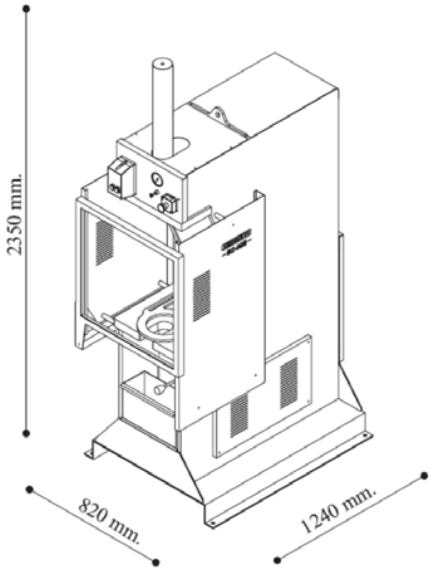
In this paper, multimedia educational materials were used during the teaching-learning process to improve application of theoretical knowledge to the development of a project. Currently, these materials are increasingly used by companies to exhibit their products and production methods and can contribute, if these are used as educational resources (MEC, 2006), to provide students a much closer view of the industrial environment in which they will have to develop their professional activity. The results obtained after their implementation are exposed as well.

2. Methodology

This work was developed through four stages, which include different activities. Each of these stages are described below.

2.1. Elaboration of educational materials

In the first stage, technical specifications of a wide variety of machinery and industrial equipment was compiled and updated. Datasheets of machines and equipment used in manufacturing, treatment or ending processes of metallic components were elaborated. In addition, information about the methods of working with these machines was analyzed to create numerous educational materials. For example, the technical characteristics of a vertical broaching are shown in Fig. 1 and the operation method for making a groove or a notch in one metal piece is described in Fig. 2.



Vertical broaching BM - 25

Máquina	
Maximum Force	10 Tm
Forward velocity	25 mm/s
Backward velocity	54 mm/s
Weight	790 Kg
Sound level	70 dB
Motor	
Power	2.2 Kw
Voltage	230/380 V
Intensity	9/5 A
Velocity	1460 rpm

Fig. 1. Technical characteristics of a vertical broaching.

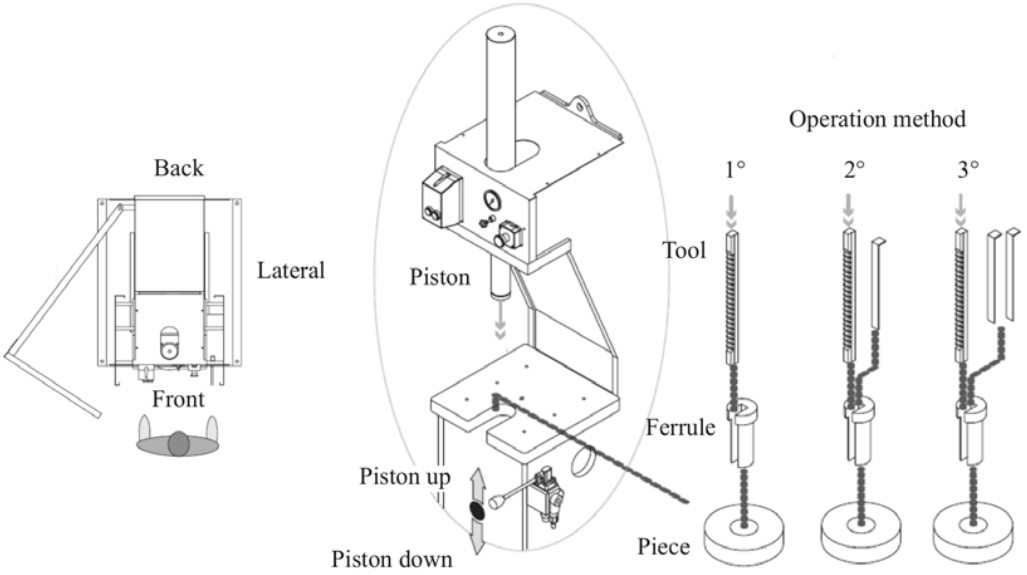


Fig. 2. Operation method in a vertical broaching.

2.2. Development of matter

All resources elaborated in the previous stage were used to explicate the subject matter and to analyze different industrial manufacturing methods.

On the other hand, audiovisual materials were used to give an idea about the sequence of activities along a manufacturing process. Fig. 3 illustrates some of these productive activities and the corresponding industrial installations where they are performed.

Make use of these resources allowed us explaining concisely a number of industrial processes. At the same time, it was possible to have more time to solve issues raised by the students and to attend to other important themes associated to the production processes. In particular, we addressed in detail the risks arising from the use of machinery and industrial equipment, the function of auxiliary installations or the obligation for put into practice appropriate maintenance and control plans.

2.3. Elaboration of technical information by the students

In order to carry out the design of an industrial plant the students, organized in groups, elaborated documents summarizing technical specifications and operation methods of the machines used in the manufacturing process developed within their industrial installation.

These documents included the following information:

- Technical characteristics of machines (total dimensions, speed, capacity, power,...). It was necessary to justify their choice for the manufacturing process.
- Safety measures and people protection procedures incorporated into each machine.
- Working method, that is, how the machine works and how the worker handles it. Audiovisual material was added to show it.

Numerous industrial equipment used in the manufacturing process of metallic components, was studied. The works were presented in class and some aspects as productivity and safety were analyzed jointly. In particular, the minimum safety measures required by the normative (RD 1435/92) were analyzed as well as other devices incorporated to protect workers from potential accidents. Fig. 4 shows the security measures that include, respectively, a machining center (Fig. 4a) and a wrapping of pallets (Fig. 4b).

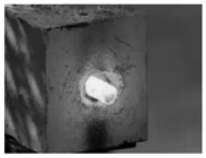
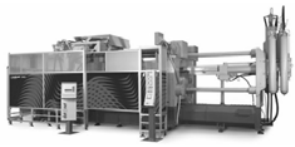
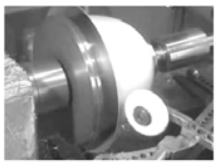
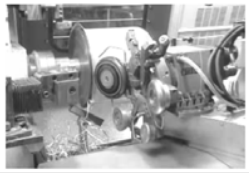
Manufacturing process	Description	Industrial installation
	a) Sheet profiling. Installation: profiling machine. Velocity range: 0 - 40 mpm. Sheet thickness: 0.3 - 1.2 mm.	
	b) Thermal treatment. Installation: induction heaters. Temperature: 760° - 1200° C. Cooling with warm water.	
	c) Inyection molding. Installation: inyection machine. Maximum pressure: 300 Tm. Production: 180 piezas/h.	
	d) Shaping aluminum. Installation: CNC lathe. Velocity: 2000 rpm. Tappet: Plastic wheel.	
	e) Surface treatment. Installation: peening machine with air conveyor. Peening mean period: 50 min	

Fig. 3. Study of manufacturing processes and industrial installations.

2.4. Industrial equipment selection.

In the last stage, students performed the analysis and synthesis of the technical information previously collected. Following, suitable machines and industrial equipment had to be adequately selected to develop the manufacturing process projected.

In the final review of the industrial plants projected by the students, the following aspects were taking into account:

- The industrial equipment was suitable to launch a manufacturing process.
- Safety measures were satisfactory.
- The organization of the productive activity was found well fitting to the expected demand.

The results obtained after the assessment of projects are shown in Table 1. It can be seen that the selection of machines and security measures was satisfactory in 86% of the projects reviewed. Auxiliary installations are adequate to the production process in 75% of the projects and only 62% of these projects show a production capacity according to the selected equipment and market requirements. Therefore, this issue needs to be improved in order to perform projects technically and economically viable.

With this purpose, the application of appropriate tools to calculate times and costs in manufacturing processes is proposed in future work.

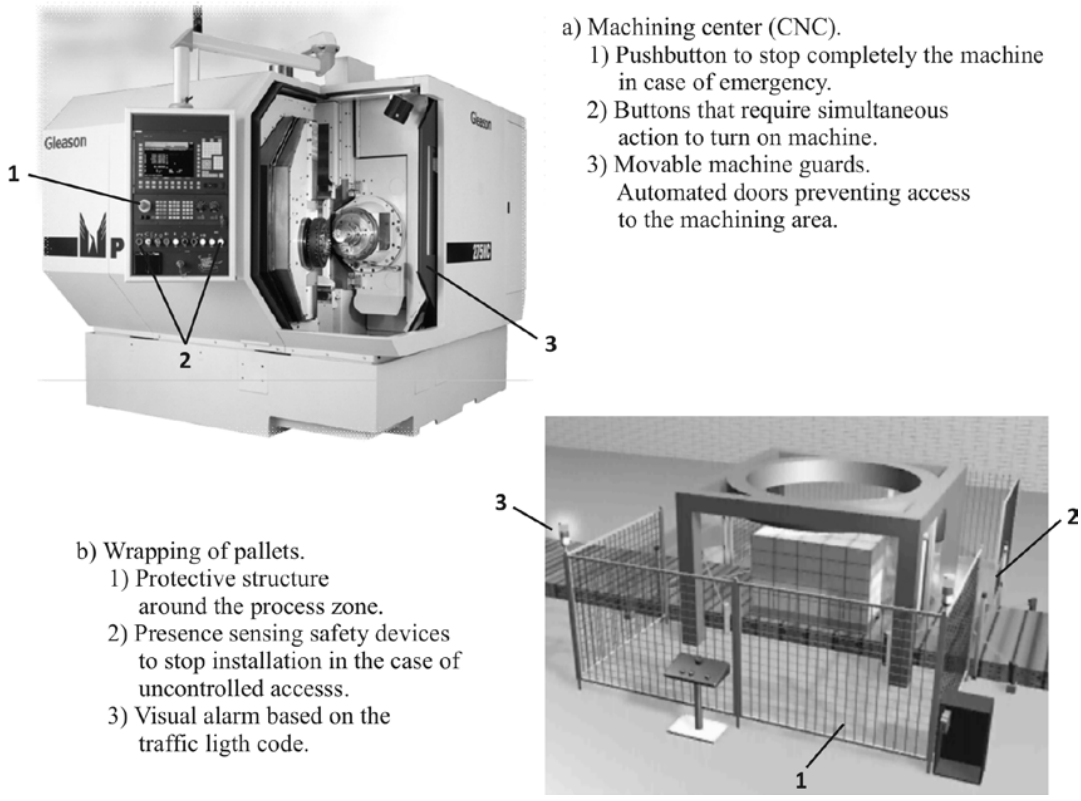


Fig. 4. Safety devices in machines.

Table 1. Results obtained in the assessment of projects.

Content	86%	75%	62%
Defining characteristic parameters of machines			
Proper selection of equipment and machines			
Implementation of safety measures			
Definition of auxiliary installations			
Realistic productive capacity			

3. Conclusions

Through this work, abundant technical information and audiovisual material on industrial equipment was gathered, which allowed us addressing in detail operations and industrial processes and developing the subject matter in a more agile and effective form.

Students elaborated documents with technical specifications of machinery and used this information to develop the project of an industrial installation dedicated to the manufacture of a mechanical assembly.

Safety measures and protection devices were correctly applied in machines and appropriate selection criteria of industrial equipment were used to carry out a manufacturing process.

Therefore, the development and use of the materials was positive. However, it is necessary to improve the analysis of the productive potential of the industrial installations in order to make projects more viable, technically and economically.

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